

THE SPOTTED GROUND THRUSH *TURDUS FISCHERI FISCHERI*  
AT GEDE IN COASTAL KENYA

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*Turdus fischeri*, the Spotted Ground Thrush, is a rare, elusive and little-known African bird with a very fragmented distribution. Four races are described, all existing in isolated patches of moist ever-green forest. *T.f. natalicus*, the largest, breeds in coastal forests in eastern Cape Province, South Africa, migrating in March to Natal and southern Kwazulu (Clancey 1955, 1957). The Malawi race *belcheri* appears to be resident, but scarce, up to at least 1500 m in the Soche and Thyolo forests near Blantyre (Benson 1950, 1952, 1954). A race, *maxis*, was described in 1982 on the basis of a specimen collected at 1250 m in the Imatong Mts, southern Sudan (Nikolaus 1982). The nominate race is known only as a non-breeding visitor between March and November to forests on the Kenya coast (Britton & Rathbun 1978). Completing this pattern of wide geographical separation, an unassigned bird has been collected at 1700 m in the Upemba National Park of southern Zaire (Benson & Benson 1975).

Only *natalicus* is thought to be reasonably common. *T.f. belcheri* persists as a very small population, while the type specimen remains the only record of *maxis* despite three years of fieldwork in the Imatongs by its discoverer (Nikolaus 1982). Mackworth-Praed & Grant (1960) considered the nominate race "probably now extinct"; there had been only two sight records since Fischer's original specimens were taken in 1885 (Benson 1950, 1954). However, a specimen was shot in Sokoce Forest in 1964 (Keith & Twomey 1968) and regular sightings subsequently established the bird as seasonally common in three tiny patches of coral rag forest at Gede, Shimoni, and Jadini. There appears also to be a seasonal presence at a much lower density in Sokoce Forest, and a few records have been obtained elsewhere on the coast (Britton 1980, Britton & Rathbun 1978, Britton, Britton & Coverdale 1980). The birds' breeding grounds are unknown. This study was undertaken to assess the status and general ecology of the nominate race at Gede; it was carried out during July and August 1983 as part of the University of East Anglia - International Council for Bird Preservation Arabuko-Sokoce Forest Expedition.

## METHODS

Gede Ruins National Monument (3.18'S, 40.01'E) protects the ruins of a fifteenth century Afro-Arab town. The 44-ha site, on coral rag, has been cleared around the main excavations but is otherwise covered with dense semi-deciduous lowland forest (Moomaw 1960).

Mist nets were used at eight sites distributed across the forested area (Fig. 1), from 10 to 17 and 22 to 25 July. Choice of site was constrained by the availability of suitable small paths or trails;

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these usually required some clearing, and the net lengths used varied. Several sites were operated simultaneously, the nets being open at each for two morning and two afternoon sessions (i.e. one evening, the whole of the next day, and the morning following that). Nests were opened at 06:00 and closed at 18:30.

Weights and wing-lengths were taken for all species caught; in addition, all *T. fischeri* were individually colour-ringed, with colour combinations chosen to minimize possible confusion in dim light. Relocation and observation of colour-ringed birds continued at intervals until 19 August, and retrapping was organized at sites A and C (Fig.1) on 8 and 9 August. Some habitat assessment (described below) was un-

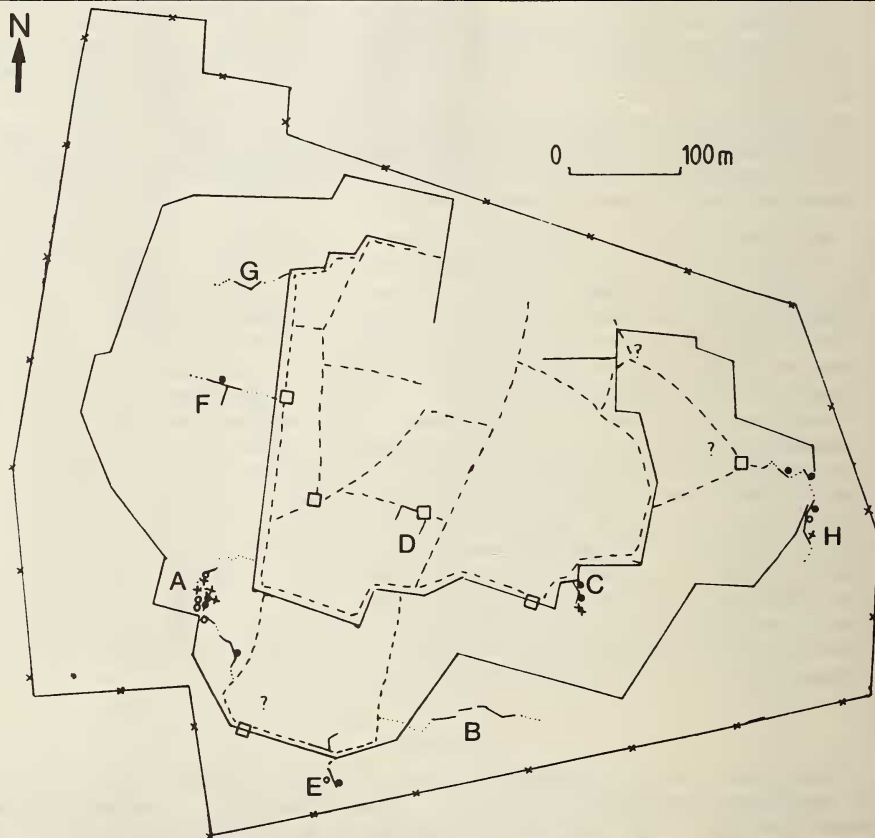


Fig. 1. Map of Gede Ruins National Monument. Key: ---- path, □ruined building, — ruined wall, \*—\* forest edge, A - H are net sites, ● Ground Thrush first caught, ○ retrap, x relocation, — position of net, ? sighting of unringed bird.

dertaken towards the end of the study period. This report also includes data for *T. fischeri* captured during the expedition's work in

the adjacent Sokoke Forest (Kelsey & Langton 1984).

## RESULTS AND DISCUSSION

Ten *Turdus fischeri* were captured at Gede, and three in Sokoke Forest. Mean wing-length was 118.3 mm (range 114 - 121 mm) and mean weight 58.2 g (range 53 - 62 g). Six recaptures were made at Gede, and three colour-ringed individuals were relocated (Fig. 1). Three of the marked individuals at Gede were neither relocated nor retrapped.

### General habits

The species was at all times very difficult to observe, being silent, shy, and extremely well camouflaged. The birds were markedly terrestrial; when disturbed on the ground they generally stood quite still, remaining motionless for up to six minutes before beginning to forage once more in a typical thrush fashion, making one or two rapid hops then plunging the beak repeatedly into the leaf litter.

### Vocalizations

The South African race *natalicus* has a rich musical song uttered from high in a tree (Chiazzari 1952). The only vocalization identified at Gede was a very quiet, thin *tswee* call made while the bird foraged. Song has been heard at Diani (Jadini) south of Mombasa (Irvine & Irvine 1977b) and birds there have sung in response to recordings of the song of the race *natalicus*; the nominate race's song at Diani proved, however, to be quite distinct (R. McVicker pers. comm.) and is heard throughout the birds' stay in Kenya.

### Activity

Capture and relocation timings suggest that the species is most active early and late in the day. None was caught between 09:20 and 17:00, although one bird (B/Y) was observed foraging actively at 11:20, suggesting that a steady low level of activity may be maintained throughout the middle hours. Taking all records together, there is no suggestion of greater activity in the morning than the afternoon hours, or vice versa (29 morning, 20 afternoon sessions; 15 morning, 8 afternoon records:  $\chi^2$ -test;  $P > 0.1$ ).

### Home range

All recaptures and relocations were very close to the original capture points. The greatest displacement was 40 m in the case of the immature bird, R/W; all others (13) were below 30 m, and most were much smaller than this. Site fidelity was not just a short-term phenomenon; for example, R/DG and DG/W were retrapped a few metres from their original capture points over a month after they were colour-ringed. It thus seems appropriate to regard individual *T.f. fischeri* as moving and foraging within a well-defined home range. By contrast, retrap data for the Red-capped Robin Chat *Cossypha natalensis* (another migratory thrush occurring at Gede: Britton & Rathbun 1978) show that movements between net sites, involving distances of more than 100 m, were not uncommon.

No territorial interactions were observed in *T.f. fischeri*; indeed, no two birds were ever seen in close proximity. Some, though, may have had partially overlapping home ranges; for instance, DG/W and R/DG were initially caught in the same net at site A, and DG/W was re-trapped within the known home range of R/DG. At net site C, birds B/Y and W/LG had capture points very close together.

Two birds, R/DG and B/Y, were located often enough to allow the calculation of home range areas (Fig. 2). The method employed was that of

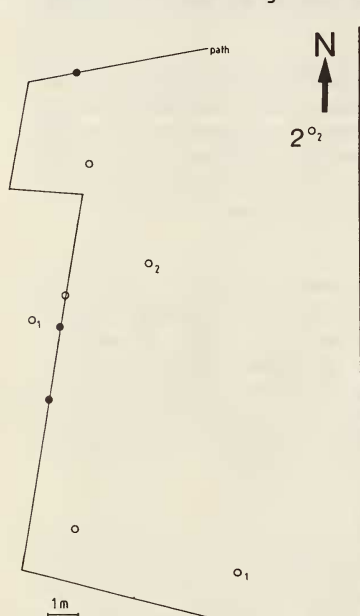


Fig. 2. Location points for bird R/DG at net site A, used to calculate home range area. Sightings with the same number are temporally linked, representing the first and last points where a bird was observed on a single occasion. ○ seen, ● caught.

Jennrich & Turner (1969) which relies on the covariance matrix of the location points: the points were mapped on to an arbitrary Cartesian grid, and the area calculated from their co-ordinates using the appropriate formulae. Of relatively simple methods this gives the most accurate and stable estimate with a small sample, and is the least sensitive to temporal contingency in the points used (Ford & Myers 1981). Calculated areas were 1360 m<sup>2</sup> for R/DG and 1347 m<sup>2</sup> for B/Y. The similarity of these values may be fortuitous; certainly they must be regarded as minimum estimates for the utilized areas, since it is likely that birds were more difficult to detect the further away they were from the net site paths.

#### Relative abundance

The ringing results suggest that *T.f. fischeri* was the second most abundant forest floor bird at Gede in July and August, after *Cossypha natalensis* (Table 1). Britton & Rathbun (1978) gave second place to the Eastern Bearded Scrub Robin *Cercotrichas quadrivirgata*; this is a much more conspicuous bird than the ground thrush and observers have probably overestimated its relative numbers in the past. Pooled results from Sokoke Forest show that there *C. quadrivirgata* is, overall, the more abundant of the two (Table 1); however, the Sokoke survey covered a number of different habitat types, so it is not possible to make a straightforward comparison.

#### Age structure

Only one immature Spotted Ground Thrush was caught at Gede; the immature:adult ratio was much lower than in either of the other terrestrial thrushes (Table 2: data from Gede and Sokoke combined). This scarcity of immature birds was unexpected. Kenyan ringing records for the species from 1972 to 1981 indicate that, of 19 birds handled, 10 were

TABLE 1

Total numbers caught of three ground-dwelling thrushes

	Sokoke Forest	Gede Ruins
<i>Cossypha natalensis</i>	49	37
<i>Turdus f. fischeri</i>	3	10
<i>Cercotrichas quadrivirgata</i>	17	5

adults, 3 "fully grown" and 6 immature. Conservatively counting the "fully grown" birds as adults gives an immature:adult ratio for this period of 1:2.2, comparable to the ratio found here for *Cossypha natalensis*. Given this proportion, the chance that no more than one bird out of thirteen caught would be an immature is significantly small, although only barely so (binomial test;  $P = 0.05$ ). There are several possible reasons for this apparent difference in age structure. Most obviously, it could be caused by unusually poor breeding success in the season prior to the study. However, unlike this study, the ringing data for past years include presumed passage periods, as they cover all months from April to October; they also include records from Bamburi, Jadini, Mrima and Shimoni as well as Gede and Sokoke. Adult birds might well exclude immatures from areas of optimum habitat, such as Gede appears to be, so that a larger proportion of immature birds would be captured during passage periods and in sub-optimal forest tracts. With only 19 past records there is unfortunately little scope for subdivision to test this idea. Despite the tiny samples though, it is of interest to examine the coral rag forests (Gede, Jadini and Shimoni) together. Here the immature:adult ratio is 1:2 for the pre-

TABLE 2

Immature:adult ratios for three ground-dwelling thrushes  
[ringing results pooled for Sokoke Forest and Gede Ruins]

	Total no. immatures	Total no. adults	Immature:adult ratio
<i>Cossypha natalensis</i>	29	57	1:2.0
<i>Turdus f. fischeri</i>	1	12	1:12.0
<i>Cercotrichas quadrivirgata</i>	8	14	1:1.8

sumed resident period (taken as the second half of May to the first half of September, inclusive; six birds) and 1:1 for dates outside this (four birds).

#### Population size

Because the Spotted Ground Thrush is so hard to see, and the number of birds caught was small, conventional methods of population size estimation are inapplicable. To overcome this difficulty a simple techni-



que was devised that uses the calculated home ranges to obtain an estimate of the total area sampled during netting (see Appendix). Using this, the estimated population density is 2.9 birds/ha, giving a total of 113 *T.f. fischeri* in the 39 ha forest area. These are upper limits; if the true home ranges were indeed larger than calculated, then the density estimates would be reduced accordingly.

The overall population density in Sokoke Forest is presumably much lower than that at Gede Ruins; a direct comparison is impossible, but while much more mist-netting took place in Sokoke than at Gede (Kelsey & Langton 1984), only three Spotted Ground Thrushes were caught there. Because of the forest's still considerable area, some 37 200 ha, even a low overall density of *T. fischeri* could imply a sizeable population. However, only some 28 per cent of the forest is still undisturbed, and this proportion is diminishing constantly (Kelsey & Langton 1984).

#### Diet

Attempts during this study to determine diet (by use of tincture of ipecacuanha to induce regurgitation) proved unsuccessful). From stomach contents, Chiazzari (1952) described the diet of the race *natalicus* as "grubs and insects". Three specimens of the nominate race in the National Museum, Nairobi, had fragments of small millipedes *Prionopetalum* spp. in their stomachs, while the stomach of a bird from Sokoke Forest collected in July contained seeds and fruit pulp (Britton & Zimmerman 1979).

Ants have been suggested as part of *T.f. fischeri*'s diet (Mackworth-Præd & Grant 1960, Burrell & Abel 1976). Large swarms of ants *Dorylus* sp. are often encountered at Gede Ruins, and attract considerable numbers of forest birds: for example *Cossypha natalensis*, *Cercotrichas quadrivirgata*, and *Nicator Nicator chloris*. *Turdus fischeri* was never observed in these feeding parties. In one instance, a swarm was watched for 3½ hours in the home range of R/DG; R/DG itself appeared after 2½ hours, perched near the edge of the swarm for some ten seconds, then flew away from the bird party and was lost to view.

On the available evidence, *T.f. fischeri* thus appears to be a generalist ground feeder, but a solitary one that may actually avoid parties of feeding birds.

#### Habitat preferences

A survey was carried out to assess several habitat variables (mainly related to the amount of shade cast by the upper canopy). Ten sites were selected, five in the assumed home ranges of individual ground thrushes and five at net sites where none of this species had been caught or observed. At each four 4-m<sup>2</sup> quadrats were sampled, one each 10 m north, south east, and west of an arbitrary point along the track. The following were assessed: relative proportions of bare soil, leaf litter and low herbaceous growth; the numbers of woody plants in each of four size groups; the degree of undergrowth tangle on a 0-5 scale; leaf litter thickness (the average of the number of fallen leaves at four specified points within the quadrat).

The results (Table 3) show that the Spotted Ground Thrush appears to prefer habitat characters associated with deep shade: nearly complete canopy cover, extensive, thick leaf litter, and a relatively sparse growth of small saplings. The impression was that the birds' home ranges included one or more densely shaded glades, rather open at ground level, with nearby areas of low, thick, undergrowth, tangled with dead wood and vines, where they retreated when threatened.

TABLE 3

*Quadrat results averaged for T.f. fischeri home ranges ("+SGT") and net sites where no T.f. fischeri were caught ("-SGT")*

Variable	means: + SGT	means: - SGT	significance of difference <sup>1</sup>
Depth of litter (1-5)	3.3	1.8	P < 0.01*
Soil cover, per cent	37.9	40.6	NS
Leaf cover, per cent	51.3	36.1	P 0.05
Herb cover, per cent	10.8	24.3	NS
Trees class A, <0.5m high	8.6	20.0	NS
Trees class B, 0.5 - 2m high	4.0	10.4	P 0.05
Trees class C, 2 - 4m high	1.2	2.0	NS
Trees class D, >4m high	2.6	2.0	NS
Tangle (0-5)	3.3	3.4	NS*
Canopy cover, per cent	90.4	75.6	P 0.005

Notes: <sup>1</sup> = t-test, except \* = Mann-Whitney U-test

#### Facial skin

All the *T.f. fischeri* caught had a small patch of bare skin behind each eye. This patch was coloured pink in six of the birds, and purplish-blue in six of the others (the colour was unrecorded for one). Two specimens in the collection of the National Museum, Nairobi, a male and a female, both have the patch coloured "dark pinkish", as recorded on the labels. This thus seems unlikely to be a sexually dimorphic character, despite the proportions observed.

#### Moult

All but four of the Spotted Ground Thrushes handled had completed wing moult, including the first three birds captured (on 10 July) and all five caught after 25 July. The four still moulting were well advanced in replacement (primary scores, out of 50, were 38, 45, 47 and 49). Moult thus appears to be completed by the end of July. A specimen (No. 12287) in the National Museum, collected on 5 May 1966, was in early moult (primary score 5) suggesting initiation shortly after arrival in the non-breeding quarters. To set against this, a bird ringed in Sokoke by P.B. Taylor on 3 May 1981 had fresh primaries, indicating replacement was already completed. Further information is re-

quired before any conclusion can be drawn.

#### General discussion

The results confirm that the Spotted Ground Thrush occurs at a much greater overall density at Gede Ruins than in the nearby Sokoke Forest. Britton & Rathbun (1978) suggest three reasons why the Gede Ruins forest might be preferred: 1) the accumulated detritus from the prolonged occupation of Gede might have improved feeding opportunities 2) the birds might favour wetter areas of lowland forest, with rainfall greater than 1000 mm/yr, 3) there might be a preference for the uneven ground characteristic of coral rag.

The 'accumulated detritus' hypothesis is unsatisfactory, since *T. fischeri* shows a high seasonal abundance not only at Gede but also at Jadini (Diani) and Shimoni (Britton 1980, Britton & Rathbun 1978, Irvine & Irvine 1977a, 1977b, M.A.C. Coverdale pers. comm.). The birds' preference appears to be for coral rag forest in particular, not simply for wet lowland forest: they are not more common in the lowland rain forest sector of Sokoke than in the drier habitat types there (Britton & Zimmerman 1979). The ground thrushes recorded in Sokoke during the study period were captured in *Azelia* forest (two birds) and dry *Cynometra* thicket (one bird; Kelsey & Langton 1984). Substrate evenness could conceivably affect the birds' habitat choice, but it seems more likely on present evidence that they are selecting sites with particular vegetation characteristics: areas of closed canopy providing deep shade, thick leaf litter and scant or patchy low vegetation. The capture site of the *Cynometra* bird in Sokoke corresponded precisely with this description; the canopy was much lower than at Gede but almost completely closed (unfortunately the capture sites of the other two Sokoke birds could not be visited). The species' higher density on coral rag could thus be explained if tracts of structurally suitable habitat occurred there more commonly than in the other coastal forests. There is some evidence for this from transect work carried out to create vegetation profiles of Sokoke habitats (Kelsey & Langton 1984). It is possible too that soil type and high rainfall combine in the coral rag forests to improve conditions in the leaf litter for the ground thrush's invertebrate prey. In this respect it would be interesting to compare invertebrate productivity in structurally similar areas of Sokoke and Gede.

Further ringing is required to establish whether the apparent scarcity of immature birds at Gede is a real phenomenon, and, if so, what its causes are. However, this finding does illustrate clearly the importance of locating *T.f.fischeri*'s breeding grounds. Other races are restricted to small patches of forest where the threat of habitat destruction may be great.

As migratory coastal races, nominate *fischeri* and *natalicus* may be contrasted with the apparently sedentary inland races *belcheri* and *maxis*. The species, like the African Pitta *Pitta angolensis*, is one of the very few true forest birds in Africa to show anything more than altitudinal migration (Benson 1981). Britton & Rathbun (1978) find



"surprising" the movements of the nominate race away from the Kenya coast in months when food is readily available in the leaf litter. As in any migratory species, however, events elsewhere must also be taken into account; movements might, for instance, be timed to coincide with a peak in food abundance in the breeding quarters. The onset of seasonal rains usually has a direct effect on food supply, with insects abundant in the early rains and remaining numerous until the end of the wet season (Curry-Lindahl 1981). The Spotted Ground Thrush migrates from the Kenya coast as the rains there end and those in the southern tropics begin. The birds reappear in Kenya around March (Britton & Rathbun 1978) at the start of the coastal wet season (Britton 1980). If rainfall is the primary factor influencing the species' migration, it seems most likely that the birds breed in northern Mozambique, as suggested by Benson to S.N. Stuart (pers. comm.). Since this is one of the ornithologically least known areas of Africa (Brooke 1984), and *T.f. fischeri* one of the more elusive of African birds (Benson 1950, Chiazzari 1952), the undetected existence of a small breeding population is not implausible. There is some mystery, however, in the complete absence of records for Tanzania south of Pangani (Britton & Rathbun 1978).

Despite the high density of non-breeding *T.f. fischeri* at Gede and other coral rag forests, Sokoke Forest may well support the largest total population while the birds are in Kenya. The results of this study suggest that the Spotted Ground Thrush is unlikely to tolerate much modification of its habitat; while the future of the Gede Ruins forest seems reasonably secure, the proportion of primary forest remaining in Sokoke continues to dwindle (Kelsey & Langton 1984). Much more effective conservation measures must be introduced there if *T.f. fischeri*, and other rare animals, are to survive.

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## APPENDIX

### CALCULATION OF POPULATION SIZE

Consider a population of birds within a closed area A.

Assume

- 1) birds have circular home ranges, radius  $r$  (these may overlap to any extent);
- 2) a mist net placed within A will catch all those birds whose home range it intersects, i.e. all those with home range centres distant  $\leq r$  from the net.

If several net lengths are used (separated from each other by  $< 2r$  at all points), the density of home range centres in the surrounding area is given by

$$d = N / (2Lr + i\pi r^2 / 2)$$

where

$N$  = total number of birds caught

$L$  = total net length

$i$  = number of free net ends

This provides an estimate of the overall density of home range centres - i.e. of birds - in A.

The trapping and observation results indicate that assumption 2) is probably valid for *T.f. fischeri* at Gede. The home range circularity assumed in 1) is for mathematical convenience; the estimate should not be greatly in error if the assumption is invalid, provided that home ranges are oriented randomly with respect to the nets. Net sites were well distributed over the forest, which should increase the estimate's accuracy.

In this case,  $r = 21$  m,  $L = 513$  m (including short gaps between nets),  $i = 18$ ,  $N = 10$  and  $d = 2.9$  birds/ha. The forest area at Gede is some 39 ha, giving a total population of 113 *T.f. fischeri*. The figures calculated must be upper limits, since  $r$  may well be underestimated.

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